GUIDELINE A-1
(formerly 01-01 & 01-03)

Combustion and Air Pollution Control Requirements for New Municipal and Biomedical Waste Incinerators

Legislative Authority:

Environmental Protection Act, Part V, Section 27, and Part II, Section 9
Ontario Regulation 347, General -- Waste Management Regulation
Ontario Regulation 346, General -- Air Pollution

Responsible Director:

Director, Science and Technology Branch

Last Revision Date: April, 1994

TABLE OF CONTENTS

SYNOPSIS

This guideline applies to municipal and biomedical waste incinerators. The Ministry will enforce the guideline by imposing conditions on Certificates of Approval in accordance with the requirements of the *Environmental Protection Act*, Part V, Section 27, and Part II, Section 9.

The guideline seeks to minimize contaminant air emissions from new incineration systems by requiring proper control of the combustion process and establishing minimum design and operating parameters for the evaluation of combustion. The Ministry will also consider these parameters when evaluating existing incinerators and assessing proposals for their upgrading.

The guideline also requires the installation of state-of-the-art air pollution control systems, sets air emission limits for particulate and hydrogen chloride, and establishes requirements for the control, monitoring and performance testing of incineration systems. Emission limits specified in this guideline will be reviewed and updated from time to time by the Ministry to reflect best available test data and control guidelines and/or regulations published by the Canadian federal government and others. Control systems which comply with the requirements of this guideline will also reduce the emissions of metals and acidic gases.

1.0 Introduction

Regulation 347, Section 12.1, with specific exceptions, prohibits the establishment or operation of municipal waste incinerator sites in Ontario. The exceptions include:

- incinerators for which approval to proceed was given under the *Environmental Assessment Act*, or for which a Certificate of Approval (or provisional Certificate of Approval) was issued under Part V of the *Environmental Protection Act* on or before September 26, 1992;

- incinerators put into operation before September 26, 1992 for which no Certificate of Approval was required under Part V of the *Environmental Protection Act*; and

- incinerators designed to exclusively handle the incineration of unpreserved wood waste, pulp mill sludge, paper mill sludge, paper de-inking sludge, animal carcasses (not pathological waste), and waste which would be hazardous or liquid industrial waste, except for applicable small quantity exemptions.

This guideline establishes minimum design and operating parameters, emission control systems and emission limits which will ensure control of emissions to the atmosphere from incinerator systems. It also provides criteria which the Ministry will consider for evaluating existing incinerators and assessing proposals for their upgrading.

The requirements specified in this guideline are in addition to those in Regulation 346 (RRO 1990), General -- Air Pollution, including compliance with the point of impingement standards prescribed in Schedule 1 to that regulation.

The requirements are also in addition to those in Guideline C-4: "Management of Biomedical Waste in Ontario".

2.0 Definitions

Burner Flame Front:
The visible luminous front zone of the flame, formed by the burner, in which intense localized gas phase combustion occurs.

Combustion Air:
The air supplied to the incinerator for the burning of the waste and/or the fuel.

Combustion Gas Residence Time:
The mean period of time, after most of the mixing and combustion has been completed and the temperature fully developed, during which the combustion gases are maintained at the specified minimum temperature and oxygen content.

Feed Rate:
The weight of waste introduced or fed into the incinerator per unit time.

Gas-Phase Turbulence:
Turbulence in the combustion gases, denoting an irregular fluctuation (i.e. mixing and eddying) superimposed on the main stream. Good mixing of the products of incomplete combustion (primarily carbon monoxide and hydrocarbons) and of the combustion air is promoted by a highly turbulent flow of the gases.

Negative Pressure:
A pressure that is less than ambient pressure.

Operating Parameters:
The variables of the incinerator process and waste stream used to control the operation of the incinerator. These include: the waste feed rate, composition, and heating value; combustion air feed rate(s); and heat losses and production.

Primary and Secondary Chambers:
The primary combustion chamber, also called the lower or combustion chamber, is where the waste is introduced, progressively dried, volatilized (gasified), ignited and combusted. Combustion is maintained by supplying the chamber with combustion air and heat from the primary chamber burner when necessary.

The gases flow from the primary combustion chamber to the secondary combustion chamber, also called the afterburner, where additional combustion air is mixed with the combustible gases to ensure their complete combustion.

Reference flue gas conditions:
Reference flue gas conditions are defined as follows:

·	Temperature	25°C
·	Pressure	101.3 kPa
·	Oxygen content	11%
·	Water content	nil (dry conditions)

Residual Oxygen:
The amount of oxygen (usually expressed in percent on a dry basis) in the combustion gases exiting the secondary combustion chamber or the location where the one-second residence time ends.

Single Chamber Mass Burning Incinerator:
A single chamber incinerator with a waterwall or refractory-lined construction, a grate onto which the waste is fed, and provisions for the supply of combustion air both beneath (underfire air) and above (overfire air) the grate. The waste is usually introduced into the incinerator with little or no pre-processing.

Spreader Stoker Incinerator:
A single chamber incinerator in which waste is blown with air into the incinerator furnace through a pneumatic charging system. Waste is burned in suspension and on a travelling grate. The incinerator includes provisions for the supply of combustion air both beneath (underfire air) and above (overfire air) the grate.

3.0 Abbreviations

HCl	hydrogen chloride or hydrochloric acid
kg/h	kilograms per hour
kPa	kilopascals
O_2	oxygen
ppmv	parts per million by volume
R	reference conditions

4.0 Guideline Requirements

4.1 Combustion in Incinerators

4.1.1 Incineration Temperature

Incinerators shall be capable of maintaining, on a continuous basis, an incineration temperature of at least 1100°C, and shall operate at a temperature of not less than

1000°C. They shall incorporate an auxiliary burner to provide this minimum operating temperature:

- at start-up before the commencement of the incineration cycle;
- during shutdown until all combustion of waste has ceased; and
- when necessary during other phases of operation.

4.1.2 Combustion Air Distribution

Primary and secondary combustion air systems for incinerators shall be designed to control air distribution. Control systems shall provide the capability to adjust the distribution of combustion air and to automatically adjust the quantity of combustion air to respond to the range of waste properties, incinerator feed rates, and irregularities in loading and/or burning patterns in the incinerator.

4.1.3 Residence Time

Incinerators shall be designed for a combustion gas residence time of not less than one second at 1000°C. This residence time shall be calculated from the point where most of the combustion has been completed and the incineration temperature has fully developed.

(a) Multi-chamber Incinerators

In multi-chamber incinerators, the residence time shall be calculated from the secondary burner(s) flame front. If air is introduced downstream of the burner flame front, residence time shall be calculated from the final air injection point.

(b) Single-chamber Incinerators

Where the furnace is one continuous space, such as in "spreader stoker" and "single chamber mass burning" designs, the location of the complete combustion/fully developed temperature point shall be determined by an overall design review, and may be significantly downstream of the final air injection point.

4.1.4 Oxygen Availability

Incinerators shall be designed to provide and shall operate at not less than 6% residual oxygen in the flue gas exhaust during the incineration cycle.

4.1.5 Turbulence and Mixing

Incinerators shall be designed to provide and maintain a high degree of gas phase turbulence and mixing in the secondary combustion zone. Provisions shall include any combination of: appropriately located/directed air jets, changes of flue gas flow direction, baffling, and constriction of cross-sectional flue gas flow area.

4.1.6 Range of Operation

Incinerators shall be designed to achieve the temperature, residence time, oxygen availability and turbulence requirements of this guideline over the entire expected range of values of the incinerator operating parameters, including:

- feed rate (including minimum and maximum rates);
- ultimate analysis, heating value, ash and moisture content of the waste;
- combustion air; and
- heat losses.

4.1.7 Pressure Control and Emergency Exhaust

Incinerators shall be designed to operate under negative pressure during all phases of operation. Emergency exhausts shall not be located prior to the point at which the one-second residence time at 1000°C has been achieved.

4.1.8 Control and Monitoring Systems

Incinerators shall incorporate control and monitoring systems to ensure, readily indicate and confirm that the requirements of this guideline, as well as other Ministry standards, regulations and guidelines, are consistently met. Control and monitoring systems shall be capable of readily signifying and correcting any aspect of a substandard operation.

4.1.9 Continuous Monitoring Parameters

Continuously monitored parameters shall include temperature(s), total hydrocarbons (or carbon monoxide), and opacity. Monitoring may also be required for residual oxygen, carbon dioxide, incinerator exhaust flue gas volume, hydrogen chloride, sulphur oxides, nitrogen oxides and other parameters. Continuous monitors shall be equipped with recording devices for subsequent reference and analysis.

4.2 Air Pollution Controls For Incinerators

The emission limits listed in 4.2.1 through 4.2.4 will be reviewed and updated from time to time.

4.2.1 Particulate Outlet Concentration

Air pollution control systems for incinerators shall achieve a maximum guaranteed outlet particulate loading of not greater than 20 mg/Rm^3 (Reference cubic metre).

NOTE: For mobile incinerators and incinerator units with capacities less than 400 kg/h, the outlet particulate concentration of 20 mg/Rm^3 shall be considered as a target in evaluating state-of-the-art control systems.

4.2.2 Hydrochloric Acid (HCl) Removal

Air pollution control systems for incinerators shall achieve either a guaranteed HCl removal efficiency of not less than 90%, or a maximum guaranteed HCl outlet concentration of 30 ppmv (at 11% O_2). This is equivalent to approximately 50 mg/m^3.

4.2.3 Continuous Operation

Air pollution control systems for incinerators shall be designed to operate on a continuous basis whenever there is waste burning in the incinerator. The design of the system shall incorporate consideration of:

- the conditions which could lead to an unscheduled shutdown of the air pollution control system;
- means of ameliorating such conditions; and
- air pollution control bypassing which cannot be avoided.

The incinerator system controls shall be designed to ensure the shutdown of the incinerator immediately upon an unscheduled shutdown of the air pollution control system in a manner that will minimize air emissions. The control system shall also be designed to record pertinent information for subsequent reporting to the local District Office of the Ministry, and for an assessment of the reasons for the shutdown and potential measures to prevent a recurrence.

4.2.4 Performance Tests

The Director of the Ministry's Approvals Branch will determine the frequency of performance tests.

The guaranteed removal efficiency and/or outlet loadings as described above in sections 4.2.1 and 4.2.2 shall be demonstrated by performance test programs approved by the Science and Technology Branch and, where applicable, by methods included in the Source Testing Code (Procedure A-1-1).

Performance tests shall be undertaken within six months of start-up and, thereafter, at a frequency determined by the Director. The performance test results shall be used to define the acceptable range of feed rates, operating procedures and range of readings for continuous monitoring devices. Any exceedance of the acceptable range for any monitor shall be reported to the local District Office of the Ministry.